Inshore to Offshore Environmental Characteristics and Benthic Macrofauna Along the CSESP Distributed Biological Observatory (DBO) Line in the Northeastern Chukchi Sea

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Background

The northeastern Chukchi Sea is influenced by two northward flowing water masses: Bering Sea Water (BSW) and Alaskan Coastal Water (ACW). The Alaska Coastal Water, flowing along the Alaska coastline, is warmer and less saline than offshore waters and often characterized as being relatively nutrient-poor. Bering Sea Water spreads over much of the Chukchi Sea after passing through Bering Strait with much of the flow directed through the Herald and Central Channels; it is cold, salty water transporting nutrients and plankton communities from the North Pacific.

These water masses provide the basis of inshore to offshore gradients. Benthic macrofaunal community characteristics covaried with strong inshore to offshore environmental gradients across the Chukchi Sea Environmental Studies Program (CSESP) DBO line in 2013. Due to the length of this DBO line, large transitions in both physical and biological characteristics were seen.

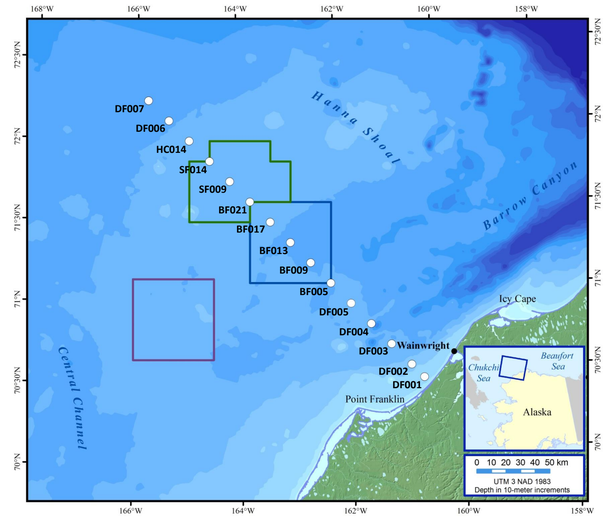


Figure 1. Stations sampled for the 2013 CSESP DBO line. Prior study areas are outlined for reference.

Environmental Characteristics

Gradients in the physical environment were related to overlying water masses. The shallower inshore benthic environment had coarser sediments, and was primarily under relatively warm ACW.

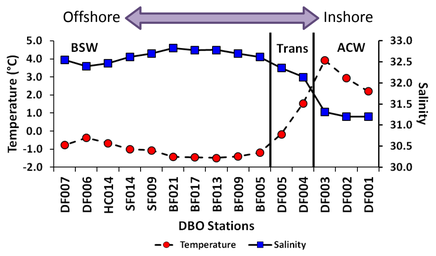


Figure 2. Temperature and salinity characteristics of bottom water along the 2013 CSESP DBO line.

Moving offshore, depth increased, sediments became finer, and bottom-water temperature decreased under BSW.

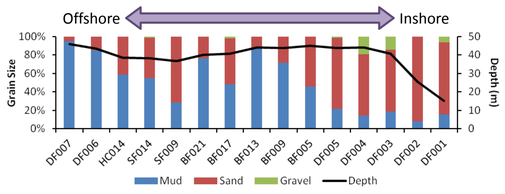


Figure 3. Sediment characteristics and water depth along the 2013 CSESP DBO line.

Complex water circulation patterns caused in part by interactions with small scale topographic features occurred through area that the central portion of the DBO line transected and resulted in a greater variation in sediment characteristics than anticipated.

Terrestrial carbon input is evident in the inshore stations as seen by the lower $\delta^{13}C$ sediment values compared to offshore stations.

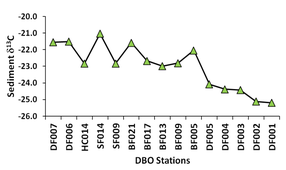
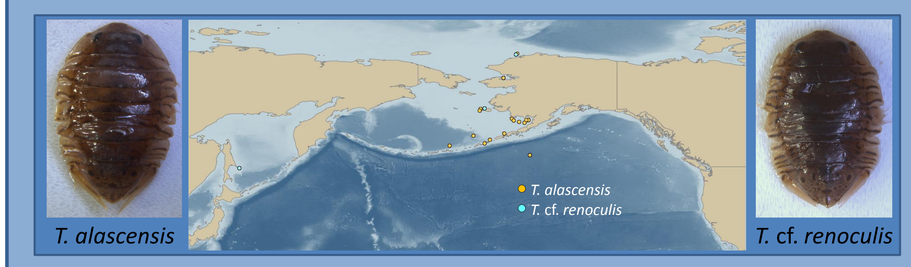


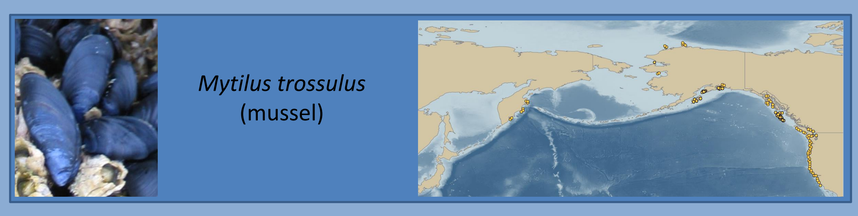
Figure 4. Sediment $\delta^{13}C$ values along the 2013 CSESP DBO line.

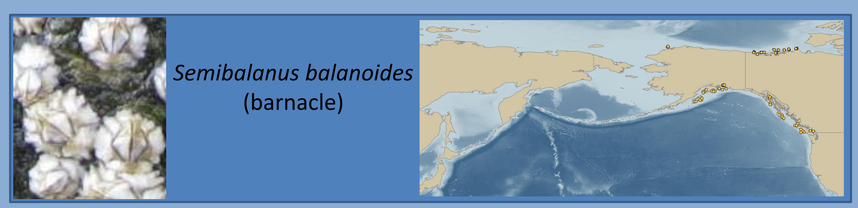
Widely Distributed Benthic Invertebrates

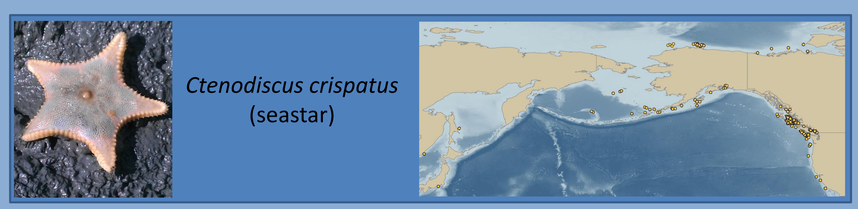
Two intertidal isopods, *Tecticeps alascensis* and *T.* cf. *renoculis*, occurred at DF001, the most inshore station. Typically known from North Pacific locations, these species demonstrate the ability of benthic invertebrates to acclimate to broad ranges of environmental characteristics and temperatures. They also highlight the northward transport of species into the Arctic Ocean from the North Pacific.



Other North Pacific species with similar distributions*:







*Data from OBIS, PVESP, and this study.

Benthic Macrofauna

At the inshore stations, benthic invertebrate communities had relatively low biomass and density. They were dominated by intertidal and disturbance-tolerant species such as the isopods *Tecticeps* spp. and nematodes, and graded to communities comprised of high densities of amphipods, including *Ampelisca* spp., *Melita* spp., *Photis* spp., and *Protomedeia* spp.

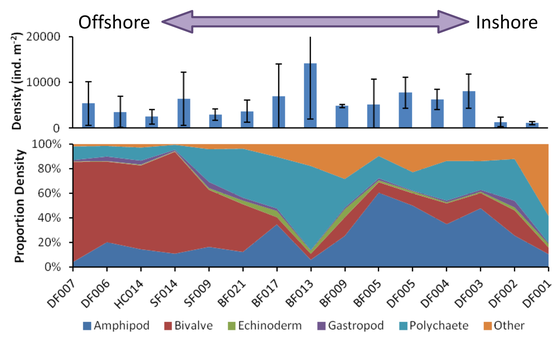


Figure 5. Benthic community density along the 2013 CSESP DBO line. Overall (top) and by major taxonomic group (bottom).

Moving offshore, benthic biomass and density peaked in these muddier habitats and then declined farther away from shore. The invertebrate communities transitioned to deposit-feeding polychaetes (*Maldane sarsi*) and suspension-feeding bivalves including *Ennucula tenuis*, *Macoma* spp., and *Nuculana pernula*.

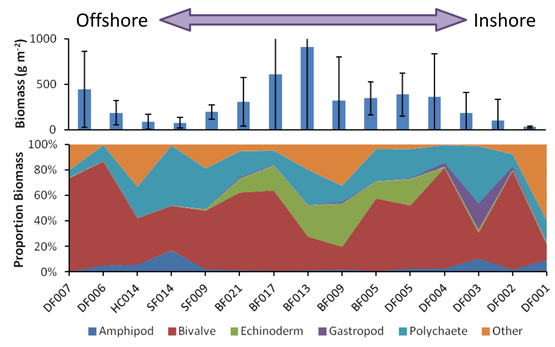


Figure 6. Benthic community biomass along the 2013 CSESP DBO line. Overall (top) and by major taxonomic group (bottom).

At the farthest offshore stations benthic biomass and density again peaked, though to a lesser extent. This small peak likely reflects a change in water circulation patterns that allows for greater transport of organic carbon to the seafloor. Community composition was similar.

Conclusions

- Overlying water masses in the northeastern Chukchi Sea helped structure strong inshore to offshore gradients in the benthos;
- The strength of the water mass/benthic macrofauna community association was weakened by a covariance with the physical stresses nearshore;
- North Pacific benthic species are good at invading and acclimating to the Arctic environment.

Acknowledgments

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